Chapter 3
Robustness and Optimality

The term 'robust' in statistics refers to insensitivity to departures from set conditions. In practical experimental designs, there are many criteria or measures of robustness. For example, robustness of designs against missing observations (the efficiency of the residual design and the connectedness of parameters in block designs, and the estimability of unknown effects), model robustness, distributional robustness, and insensitivity of designs to the presence of outliers. The first paper discusses two criteria of robustness of block designs. The second paper considers two kinds of robustness of balanced fractional 2^m factorial designs.

Roughly speaking a design is said to be optimal if the covariance matrix of the estimator, based on the design, is smaller than the ones of any other designs with same number of observations. The optimality criteria are defined by particular functions on the covariance matrix and hence on the information matrix. The theory of optimal designs has been developed by many researchers, especially, Kiefer and his school. The third paper discusses various optimality criteria of designs and the equivalence theory between optimality criteria of designs and the equivalence theory between optimalities. It also treats optimality based on the mean square error, and applies it to polynomial regression.